CLAIMS

It is claimed.

1. Means for cooling the pressure side of a turbine airfoil, said airfoil having a wall defining the outer surface on said pressure side, a mid-chord passage defined by said wall for receiving coolant, a matrix formed by a plurality of cells extending in the longitudinal direction and the chord-wise direction in said pressure side, each of said cells comprising at least two cylindrical chambers spaced in the chord-wise direction and extending in the longitudinal direction being fluidly connected to said mid-chord passage, a first fluid connection interconnecting said mid-chord passage and one of said at least two cylindrical chambers, said first fluid connection being oriented to flow coolant into said one of said at least two cylindrical chambers at a tangent so as to create a swirling motion of the coolant and a second fluid connection interconnecting said one of said at least two cylindrical chambers and the other of said at least two cylindrical chambers, and said second fluid connection interconnecting said first fluid connection and said second fluid connection being oriented to flow coolant into said other of said at least two cylindrical chambers tangentially to create a swirling motion therein and a third fluid connection discharging coolant from said other of said at least two cylindrical chambers to adjacent said outer surface.

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2. Means for cooling the pressure side of a turbine airfoil as claimed in claim 1 wherein said first fluid connection is staggered longitudinally relative to said second fluid connection.

3. Means for cooling the pressure side of a turbine airfoil as claimed in claim 1 including additional cylindrical chambers extending in the chord-wise direction, each having an interconnecting passageway fluidly connecting adjacent cylindrical chambers to each other and said passageway being oriented tangentially relative to each of said adjacent cylindrical chamber to flow coolant therein and imparting thereto a swirling motion,

4. Means for cooling the pressure side of a turbine airfoil as claimed in claim 3 wherein each of said passageways is staggered in the longitudinal direction relative to the passageways in adjacent cylindrical chambers..

5. Means for cooling the suction side of a turbine airfoil, said airfoil having a wall defining the outer surface on said suction side, a mid-chord passage defined by said wall for receiving coolant, a matrix formed by a plurality of cells extending in the longitudinal direction and the chord-wise direction in said suction side, each of said cells comprising at least two cylindrical chambers spaced in the chord-wise direction and extending in the longitudinal direction being fluidly connected to said mid-chord passage, a

first fluid connection interconnecting said mid-chord passage and one of said at least two cylindrical chambers, said first fluid connection being oriented to flow coolant into said one of said at least two cylindrical chambers at a tangent so as to create a swirling motion of the coolant and a second fluid connection interconnecting said one of said at least two cylindrical chambers and the other of said at least two cylindrical chambers, and said second fluid connection interconnecting said first fluid connection and said second fluid connection being oriented to flow coolant into said other of said at least two cylindrical chambers tangentially to create a swirling motion therein and a third fluid connection discharging coolant from said other of said at least two cylindrical chambers to adjacent said outer surface.

6. Means for cooling the suction side of a turbine airfoil as claimed in claim 5 wherein said first fluid connection is staggered longitudinally relative to said second fluid connection.

7. Means for cooling the suction side of a turbine airfoil as claimed in claim 5 including additional cylindrical chambers extending in the chord-wise direction, each having an interconnecting passageway fluidly connecting adjacent cylindrical chambers to each other and said passageway being oriented tangentially relative to each of said adjacent cylindrical chamber to flow coolant therein and imparting thereto a swirling motion,

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8. Means for cooling the suction side of a turbine airfoil as claimed in claim 7 wherein each of said passageways is staggered in the longitudinal direction relative to passageways in adjacent cylindrical chambers.

9. Means for cooling the suction side of a turbine airfoil as claimed in claim 7 wherein the direction of flow of coolant in said passageways are oriented so that the coolant is discharged as a film of coolant through said third fluid connection upstream of the gage point of said turbine airfoil whereby aerodynamic losses associated with film mixing are substantially eliminated.

10. Vortex cooling means for cooling the pressure side and suction side of a turbine airfoil, said airfoil having a wall defining the outer surface on said pressure side and said suction side , a mid-chord passage defined by said wall for receiving coolant, a matrix formed by a plurality of cells extending in the longitudinal direction and the chord-wise direction in said pressure side and in said suction side , each of said cells comprising at least two cylindrical vortex chambers spaced in the chord-wise direction and extending in the longitudinal direction being fluidly connected to said mid-chord passage, a first fluid connection interconnecting said mid-chord passage and one of said at least two cylindrical vortex chambers, said first fluid connection being oriented to flow coolant into said one of said at least two cylindrical chambers

at a tangent so as to create a vortex of the coolant therein and a second fluid connection interconnecting said one of said at least two cylindrical vortex chambers and the other of said at least two cylindrical vortex chambers, and said second fluid connection interconnecting said first fluid connection and said second fluid connection being oriented to flow coolant into said other of said at least two cylindrical chambers tangentially to create a vortex therein and a third fluid film connection discharging coolant from said other of said at least two cylindrical chambers to adjacent said outer surface to form a film of coolant there over.

11. Vortex cooling means for cooling the pressure side and suction side of a turbine airfoil as claimed in claim 10 wherein said first fluid connection is staggered longitudinally relative to said second fluid connection.

12. Vortex cooling means for cooling the pressure side and suction side of a turbine airfoil as claimed in claim 10 including additional cylindrical vortex chambers extending in the chord-wise direction, each having an interconnecting passageway fluidly connecting adjacent cylindrical vortex chambers to each other and said passageway being oriented tangentially relative to each of said adjacent cylindrical chamber to flow coolant therein and imparting thereto a vortex motion.

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13. Vortex cooling means for cooling the pressure side and suction side of a turbine airfoil as claimed in claim 12 wherein each of said passageways is staggered in the longitudinal direction relative to the passageways interconnecting adjacent vortex chambers.

14. A turbine blade having an attachment portion and an airfoil, said airfoil having a leading edge, a trailing edge, a tip, a root, a pressure side and a suction side, vortex cooling means for cooling the pressure side and suction side of a turbine airfoil, said airfoil having a wall defining the outer surface on said pressure side and said suction side , a mid-chord passage defined by said wall receiving coolant from an opening in said attachment portion, a matrix formed by a plurality of cells extending in the longitudinal direction from said root toward said tip and the chord-wise direction from said leading edge toward said trailing edge in said pressure side and in said suction side , each of said cells comprising at least two cylindrical vortex chambers spaced in the chord-wise direction and extending in the longitudinal direction being fluidly connected to said mid-chord passage, a first fluid connection interconnecting said mid-chord passage and one of said at least two cylindrical vortex chambers, said first fluid connection being oriented to flow coolant into said one of said at least two cylindrical chambers at a tangent so as to create a vortex of the coolant therein and a second fluid connection interconnecting said one of said at least two cylindrical vortex chambers and the other of said

at least two cylindrical vortex chambers, and said second fluid connection interconnecting said first fluid connection and said second fluid connection being oriented to flow coolant into said other of said at least two cylindrical chambers tangentially to create a vortex therein and a third fluid film connection discharging coolant from said other of said at least two cylindrical chambers to adjacent said outer surface to form a film of coolant there over.

15. A turbine blade having an attachment portion and an airfoil, said airfoil having a leading edge, a trailing edge, a tip, a root, a pressure side and a suction side as claimed in claim 14 wherein said first fluid connection is staggered longitudinally relative to said second fluid connection.

16. A turbine blade having an attachment portion and an airfoil, said airfoil having a leading edge, a trailing edge, a tip, a root, a pressure side and a suction side as claimed in claim 14 including additional cylindrical vortex chambers extending in the chord-wise direction, each having an interconnecting passageway fluidly connecting adjacent cylindrical vortex chambers to each other and said passageway being oriented tangentially relative to each of said adjacent cylindrical chamber to flow coolant therein and imparting thereto a vortex motion.

17. A turbine blade having an attachment portion and an airfoil, said

airfoil having a leading edge, a trailing edge, a tip, a root, a pressure side and a suction side as claimed in claim 16 wherein each of said passageways is staggered in the longitudinal direction relative to the passageways interconnecting adjacent vortex chambers.

18. A turbine blade having an attachment portion and an airfoil, said airfoil having a leading edge, a trailing edge, a tip, a root, a pressure side and a suction side as claimed in claim 17 wherein the direction of flow of coolant in said passageways is from the trailing edge toward said leading edge.

19. A turbine blade having an attachment portion and an airfoil, said airfoil having a leading edge, a trailing edge, a tip, a root, a pressure side and a suction side as claimed in claim 17 wherein the direction of flow of coolant in said passageways is from the leading edge toward said trailing edge.